Chapter 18 Reading Guide **Name:**

AP Chemistry 2016-2017 **Date:** **Per:**

Big Idea 3 encompasses the concepts of electrochemistry covered in this chapter. Oxidation-reduction reactions, voltaic cells, electrode potentials, cell potentials, and electrolysis are concepts important to understand. Content not specific to the AP Chemistry curriculum includes batteries and how they work, although the concepts are part of Science Practice 7, understanding applications across domains.

18.1 Pulling the Plug on the Power Grid

1. What is the most common type of fuel cell? Write the reaction that occurs in this cell.

18.2 Balancing Oxidation-Reduction Equations

2. Identify the steps to balancing an oxidation-reduction reaction.

3. Use the identified steps to balance $Al(s) + Ag^{+}(aq) \rightarrow Al^{3+}(aq) + Ag(s)$

4. What adjustments are made for reaction done in acidic solution? Basic solution?

18.3 Voltaic (or Galvanic) Cells: Generating Electricity from Spontaneous Chemical Reactions

5. Vocabulary: The language of electrochemistry has several words unique to this part of chemistry. Define the following.
    a. Electrical current

    b. Electrochemical cell

    c. Voltaic cell

    d. Electrolytic cell

    e. Half-cell

    f. Electrodes

    g. Amperes

    h. Volts

i. Potential difference

j. EMF

k. Cell potential

l. Standard cell potential

m. Cathode

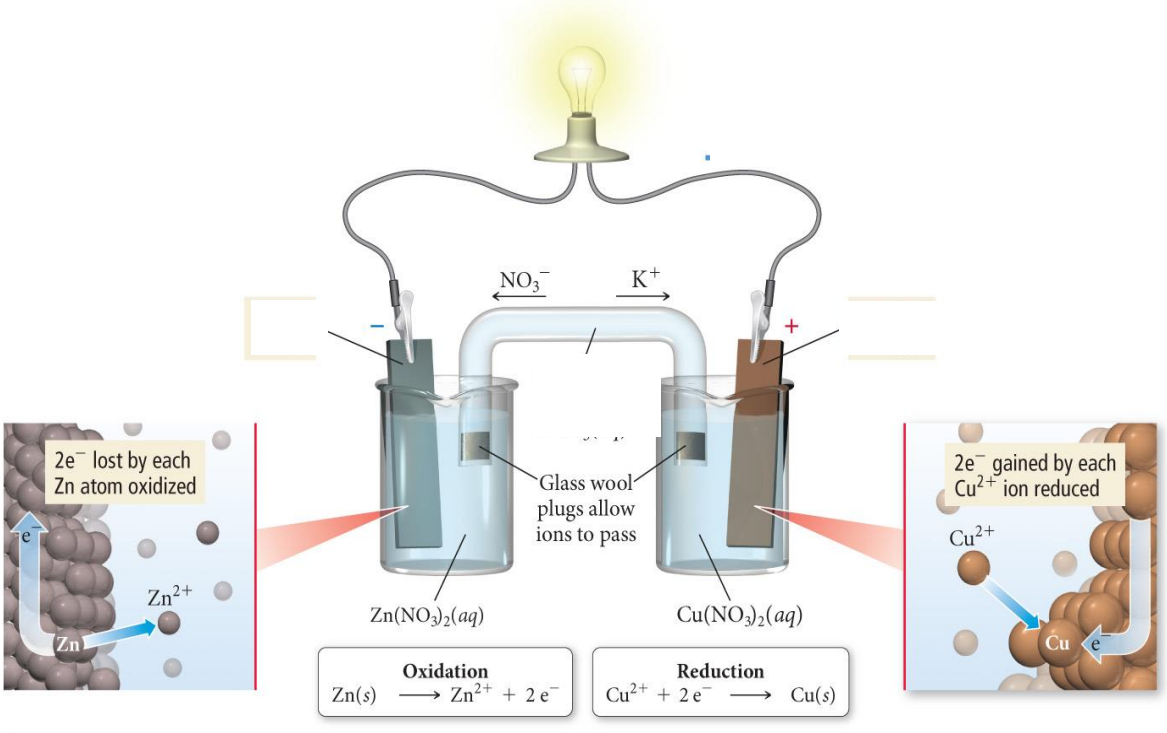
n. Anode

o. Salt bridge

6. Explain what is occurring in the beaker in figure 18.1 on page 866. What evidence supports your explanation? Write a balanced net equation for the reaction.

7. Label the following on the diagram below: anode, cathode, salt bridge, electrodes, half-cell. Draw arrows to show direction of electron flow.

A Voltaic Cell



8. Explain how electrochemical cells provide potential energy.

9. Volts are the unit used for electrical potentials. What is the volt equivalent to? What is the difference between a volt and an ampere?

10. Explain what happens when the potential between cells is zero. Why?

11. What creates current?

12. What conditions are standard for cell potential?

13. Explain what happens to the cation and anion in the salt bridge? Why?

14. Do electrons flow through the salt bridge? Explain your answer.

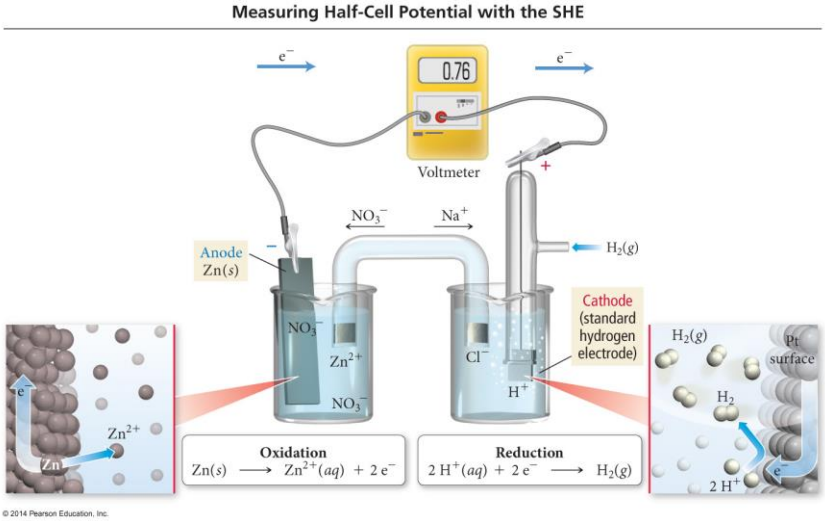
18.4 Standard Electron Potentials

15. How are standard electrode potentials determined?

16. What is the SHE and what reaction(s) occur at the SHE?

17. Is the SHE an anode or cathode. Explain your answer.

18. Explain what is happening in the figure below. What is the voltmeter measuring?



19. What is the sign for E°_{cell} that is spontaneous? Nonspontaneous?

20. How is E°_{cell} calculated?

21. What types of potentials are the standard electrode potentials found on the table?

22. Determine the E°_{cell} for the reaction $Al(s) + 3Ag^+(aq) \rightarrow Al^{3+}(aq) + 3Ag(s)$. Show work.

23. Explain how to use a reduction potential table to predict, in general, if a metal will dissolve in acid. What acid is an exception? Why?

18.5 Cell Potential, Free Energy, and the Equilibrium Constant

24. Fill in the following table

E°_{cell}	K	ΔG°	Spontaneous?
		>1	
	1		
>1			

25. What is the equation to calculate E°_{cell} from ΔG°?
    a. What does n stand for?

    b. What does F stand for?

26. What is the equation to calculate E°_{cell} from K?

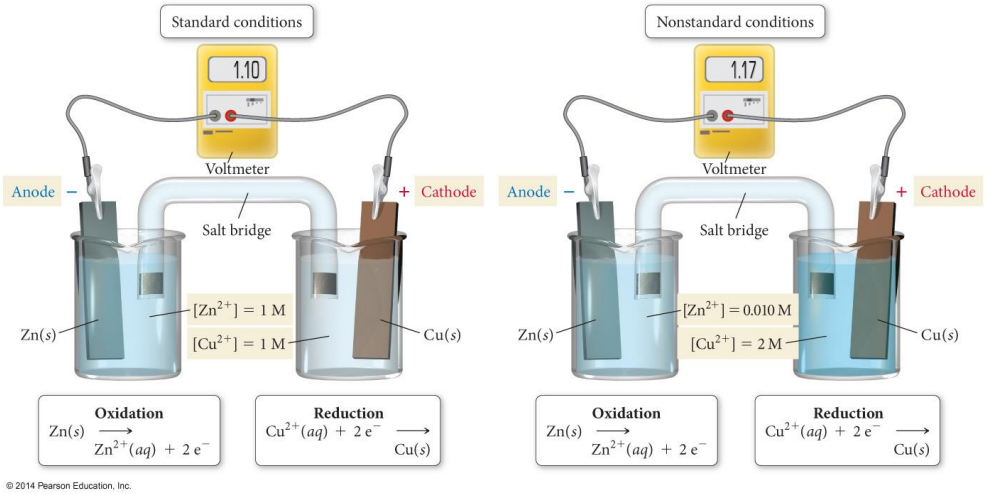
18.6 Cell Potential and Concentration

27. Why doesn't a battery last forever?

28. Fill in the following table:

Concentrations	Q compared to 1	E_{cell} compared to E°_{cell}	Le Chatelier Explanation
1M			
[product] > [reactant]			
[product] < [reactant]			
Equilibrium			

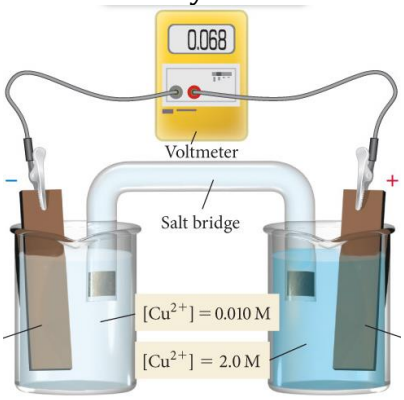
29. Explain why the voltage is higher in the second set-up when the reactions are the same.



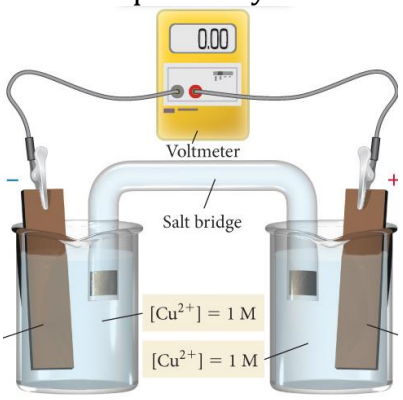
30. In a concentration cell, how can the anode and cathode be determined? Why?

a. What evidence can support the assignment of the anode and cathode as the cell runs?

31. Identify the anode and cathode. Draw an arrow in the direction of electron flow.



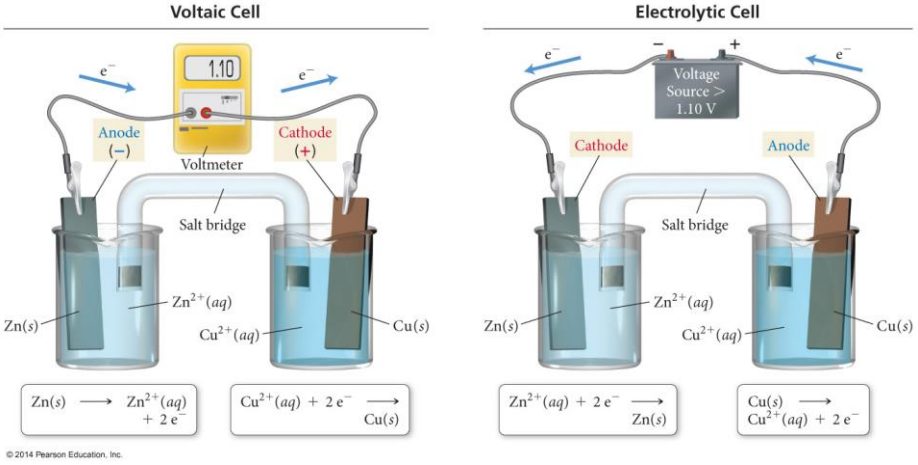
32. Explain why this concentration cell indicates zero voltage.



18.8 Electrolysis: Driving Nonspontaneous Chemical Reactions with Electricity

33. What types of reactions are electrolysis used for?

34. Using the figure, identify and explain two differences between a voltaic cell and an electrolytic cell.



35. Explain how to predict the products of electrolysis in the following (include equations as evidence):
    a. Molten KBr

    b. A mixture of NaCl and KBr

    c. Aqueous KCl

36. Explain why, when current is added to pure water, no reaction occurs, but when added to an aqueous solution, a reaction occurs.

37. How do you determine the number of moles of electrons being used in hydrolysis?

38. Identify three uses of electrolysis in industry.
    a.

    b.

    c.